

Ground Validation for the Tropical Rainfall Measuring Mission (TRMM)

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ABSTRACT

An overview of the Tropical Rainfall Measuring Mission (TRMM) Ground Validation (GV) Program is presented. This ground validation (GV) program is based at NASA Goddard Space Flight Center in Greenbelt, Maryland, and is responsible for processing several TRMM science products for validating space-based rain estimates from the TRMM satellite. These products include gauge rain rates, and radar-estimated rain intensities, type, and accumulations, from four primary validation sites (Kwajalein Atoll, Republic of the Marshall Islands; Melbourne, Florida; Houston, Texas; and Darwin, Australia). Site descriptions of rain gauge networks and operational weather radar configurations are presented together with the unique processing methodologies employed within the Ground Validation System (GVS) software packages. Rainfall intensity estimates are derived using the Window Probability Matching Method (WPM) and then integrated over specified time scales. Error statistics from both dependent and independent validation techniques show good agreement between gauge-measured and radar-estimated rainfall. A comparison of the NASA GV products and those developed independently by the University of Washington for a subset of data from the Kwajalein Atoll site also shows good agreement. A comparison of NASA GV rain intensities to satellite retrievals from the TRMM Microwave Imager (TMI), precipitation radar (PR), and Combined (COM) algorithms is presented, and it is shown that the GV and satellite estimates agree quite well over the open ocean.

1. Introduction

The Tropical Rainfall Measuring Mission (TRMM) is a satellite-based program to measure tropical rainfall and to help quantify the associated distribution and transport of latent heat, which drives the global atmospheric system. TRMM is a joint United States–Japan mission launched from Tanegashima, Japan, on 27 November 1997 (Simpson et al. 1996; Kummerow et al. 1998). TRMM has provided state-of-the-art precipitation measurements since shortly after launch and was boosted from its original 350-km orbit to a new orbit of 402.5 km in August 2001 in order to extend science observations beyond the original time frame of 2000. A key effort of TRMM has been dedicated to providing ground validation (GV) of the satellite rainfall estimates. The GV program is based in the TRMM Satellite Validation Office (TSVO) at the NASA Goddard Space Flight Center (GSFC) in Greenbelt, Maryland.

The GV program has been collecting radar and rain gauge measurements since 1988 and continues to collect datasets at a number of sites located throughout the Tropics.

The aim of this paper is to provide a summary of GV operations, algorithm descriptions, and data quality. A description of the primary GV sites and details of their operational configurations, including a description of the network of radar and rain gauge networks at each site, are provided in section 2. Section 3 discusses the software system and algorithms developed and maintained by TSVO for processing the data, details data sources and ingest methodologies, and provides a brief description of the level I–III TRMM GV Science Products (TSP) and how they are produced. Section 4 provides a discussion on the error statistics of the radar rainfall estimates versus both dependent and independent gauge measurements, as well as a comparison of rain rates and monthly accumulations between TSVO and those produced by the University of Washington. Section 5 provides validation comparisons between TRMM GV and satellite-retrieved rain intensities generated by the TRMM Microwave Imager (TMI), precipitation radar (PR), and Combined (COM) algorithms.

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